What is claimed is:

1. A method of determining lower and upper bounds for a minimum cost comprising the steps of:

solving an integer program using a relaxation of binary variables to determine the lower bound, the binary variables having values between zero and one comprising a first subset;

for the binary variables in the first subset and until no binary variables remain in the first subset, iteratively performing the steps of:

rounding up a first binary variable having a lowest ratio of a cost penalty to a performance reward; and

until no binary variables remain in a second subset, iteratively performing the steps of:

determining the binary variables in the first subset that may be rounded down without violating a performance constraint, thereby forming the second subset;

rounding down one or more second binary variables in the second subset having a zero performance reward; and

rounding down a third binary variable in the second subset having a highest ratio of a cost reward to the performance reward if none of the binary variables in the second subset have the zero performance reward; and

determining the upper bound according to the binary variables having binary values.

2. The method of claim 1 wherein the integer program comprises the performance constraint and an objective of minimizing a cost.

3. The method of claim 1 wherein the integer program models a data placement problem.

4. The method of claim 3 wherein the data placement problem seeks to minimize the cost of placing data objects onto nodes of a distributed storage system while meeting a performance requirement for a workload.

5. The method of claim 1 wherein the step of rounding up the first binary variable within the first subset further comprises calculating the cost penalty and the performance reward.

6. The method of claim 5 wherein the step of rounding down the one or more second binary variables within the second subset further comprises calculating the performance reward.

7. The method of claim 6 wherein the step of rounding down the third binary variable within the second subset further comprises calculating the cost reward.

8. A method of determining bounds for a minimum cost comprising the steps of:

solving an integer program using a relaxation of binary variables to determine a lower bound for the minimum cost, the relaxation allowing the binary variables to take values over the range of zero to one, a first subset of the binary variables comprising the binary variables having values between zero and one, the integer program modeling a data placement problem which seeks to minimize a cost of placing data objects onto nodes of a distributed storage system while meeting a performance requirement for a workload;

until no binary variables remain in the first subset, iteratively performing the steps of:

calculating a cost penalty and a performance reward for each of the binary variables in the first subset;

rounding up a first binary variable having a lowest ratio of the cost penalty to the performance reward;

until no binary variables remain in a second subset, iteratively performing the steps of:

determining the binary variables in the first subset that may be rounded down without violating the performance requirement, thereby forming the second subset;

calculating a cost reward and the performance reward for each of the binary variables in the second subset;

rounding down one or more second binary variables in the second subset having a zero performance reward;

rounding down a third binary variable in the second subset corresponding to a highest ratio of a cost reward to the performance reward if none of the binary variables in the second subset have the zero performance reward; and

determining an upper bound for the minimum cost according to the binary variables having binary values.

9. The method of claim 8 wherein the integer program further comprises a storage constraint.

10. The method of claim 9 wherein the step of determining the upper bound for the minimum cost further comprises the steps of:

determining a particular node which uses a maximum amount of storage within any evaluation interval; and

allocating the maximum amount of storage on all nodes for all evaluation intervals.

11. The method of claim 9 wherein the step of determining the upper bound for the minimum cost further comprises the steps of:

determining a maximum amount of storage for each node within any evaluation interval; and

allocating the maximum amount of storage on each node for all evaluation intervals.

12. The method of claim 8 wherein the integer program further comprises a replica constraint.

13. The method of claim 12 wherein the step of determining the upper bound for the minimum cost further comprises the steps of;

determining a maximum number of replicas for any data object within any evaluation interval; and

placing the maximum number of replicas for all data objects for all

evaluation intervals.

14. The method of claim 12 wherein the step of determining the upper bound for the minimum cost further comprises the steps of;

determining a maximum number of replicas for each data object within any evaluation interval; and

placing the maximum number of replicas for each data object for all evaluation intervals.

15. A computer readable memory comprising computer code for implementing a method of determining bounds for a minimum cost, the method of determining the bounds for the minimum cost comprising the steps of:

solving an integer program using a relaxation of binary variables to determine a lower bound for the minimum cost, the integer program comprising a performance constraint and an objective of minimizing a cost, the binary variables having values between zero and one comprising a first subset;

for the binary variables within the first subset and until no binary variables remain in the first subset, iteratively performing the steps of:

rounding up a first binary variable having a lowest ratio of a cost penalty to a performance reward; and

until no binary variables remain in a second subset, iteratively performing the steps of:

determining the binary variables in the first subset that may be rounded down without violating the performance constraint, thereby forming the second subset;

rounding down one or more second binary variables in the second subset having a zero performance reward; and

rounding down a third binary variable in the second subset having a highest ratio of a cost reward to the performance reward if none of the binary variables in the second subset have the zero performance reward; and

determining an upper bound for the minimum cost according to the binary variables having binary values.

16. The computer readable memory of claim 15 wherein the integer program models a data placement problem.

17. The computer readable memory of claim 16 wherein the data placement problem seeks to minimize the cost of placing data objects onto nodes of a distributed storage system while meeting a performance requirement for a workload.

18. The computer readable memory of claim 15 wherein the step of rounding up the first binary variable within the subset further comprises calculating the cost penalty and the performance reward.

19. The computer readable memory of claim 18 wherein the step of rounding down the one or more second binary variables within the subset further comprises calculating the performance reward.

20. The computer readable memory of claim 19 wherein the step of rounding down the third binary variable within the subset further comprises calculating the cost reward.

21. A computer readable memory comprising computer code for implementing a method of determining bounds for a minimum cost, the method of determining the bounds for the minimum cost comprising the steps of:

solving an integer program using a relaxation of binary variables to determine a lower bound for the minimum cost, the relaxation allowing the binary variables to take values over the range of zero to one, a first subset of the binary variables comprising the binary variables having values between zero and one, the integer program modeling a data placement problem which seeks to minimize a cost of placing data objects onto nodes of a distributed storage system while meeting a performance requirement for a workload;

until no binary variables remain in the first subset, iteratively performing the steps of:

calculating a cost penalty and a performance reward for each of the binary variables in first the subset;

rounding up a first binary variable having a lowest ratio of the cost penalty to the performance reward;

until no binary variables remain in a second subset, iteratively performing the steps of:

determining the binary variables in the first subset that may be rounded down without violating the performance requirement, thereby forming the second subset;

calculating a cost reward and the performance reward for each of the binary variables in the second subset;

rounding down one or more second binary variables in the second subset having a zero performance reward;

rounding down a third binary variable in the second subset corresponding to a highest ratio of a cost reward to the performance reward if none of the binary variables in the second subset have the zero performance reward; and

determining an upper bound for the minimum cost according to the binary variables having binary values.

22. The computer readable memory of claim 21 wherein the integer program further comprises a storage constraint.

23. The computer readable memory of claim 22 wherein the step of determining the upper bound for the minimum cost further comprises the steps of:

determining a particular node which uses a maximum amount of storage within any evaluation interval; and

allocating the maximum amount of storage on all nodes for all evaluation intervals.

24. The computer readable memory of claim 22 wherein the step of determining the upper bound for the minimum cost further comprises the steps of:

determining a maximum amount of storage for each node within any evaluation interval; and

allocating the maximum amount of storage on each node for all evaluation intervals.

25. The computer readable memory of claim 21 wherein the integer program further comprises a replica constraint.

26. The computer readable memory of claim 25 wherein the step of determining the upper bound for the minimum cost further comprises the steps of;

determining a maximum number of replicas for any data object within any evaluation interval; and

placing the maximum number of replicas for all data objects for all evaluation intervals.

27. The computer readable memory of claim 25 wherein the step of determining the upper bound for the minimum cost further comprises the steps of;

determining a maximum number of replicas for each data object within any evaluation interval; and

placing the maximum number of replicas for each data object for all evaluation intervals.